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(54) FOOD TREATMENT PROCESS

(71) We, CRESTON VALLEY FOODS LTD., a Canadian Company, of Creston, British Columbia, Canada, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to a process for the treatment of raw food products, in particular raw vegetables and fruit, to render them suitable for sterilization and preservation in flexible containers.

Conventional methods of bottling and canning food products, i.e. methods for the preservation of food in inflexible containers, suffer from the disadvantage that they utilize a liquid as a heat transfer medium which contributes to product oxidation and discolouration, and which is a factor in nutrient leaching. Food products processed in inflexible containers do have a fairly long preservtation period, but the product quality and organoleptic properties of the foods are poor in comparison with fresh-cooked foodstuffs, and possess a characteristic "canned" taste and appearance. Also, inflexible containers, such as cans, have disadvantages in that their capacity is limited, they tend to be heavy and of large volume, they are often difficult to open and the empty can creates a disposal problem. Thus, there has been a movement towards the use of flexible containers, such as plastic pouches, since these have the advantages of product safety in terms of sterility, large capacity range, low weight and volume (compared to cans), ease of opening, reasonable cost, and ease of disposal.

However, at present the use of flexible containers has largely been restricted to the field of frozen foodstuffs. Attempts to utilize flexible containers for packaging raw, non-frozen, food products, especially white-fleshed vegetables and fruit, have been frustrated by several problems. In particular, it has been found that during the heat processing and storage of raw vegetables and fruits in flexible containers, the intercellular gases of the foods tends to accumulate in the interior of the container, discolouration of the food tissue develops, the tissue softens considerably, off-flavours are produced and the pieces of food often tend to stick together. Several of these disadvantageous effects are caused by action of the enzymes present in the food products, and the discolouration is largely due to enzymic and non-enzymic changes in the phenolic compounds present in the foods. Previously known processes for the treatment of the food product prior to processing in flexible containers have not been successful in overcoming these disadvantageous effects and hence it has not proved possible to process raw fruit and vegetables, particularly white-fleshed fruit and vegetables, in flexible containers.

The present invention provides a method for the treatment of raw vegetables and fruit products which enables them to be processed in flexible containers without encountering any of the above mentioned disadvantageous effects. Flexible containers containing food products treated and sterilized in accordance with this invention are shelf stable without cooling or refrigeration, and the food product, when subsequently removed from the container and heated, possesses an excellent product flavour, texture and appearance.

The process of this invention comprises the following three sequential blanching steps: (a) immersing the food products in an aqueous solution of citric acid, ascorbic acid, a salt of citric or ascorbic acid, sulphur dioxide added to the solution in free form, as an alkali metal sulphite or as an alkali metal metabisulphite, or a mixture of two or more of said compounds; followed by (b)

immersion in an aqueous solution of an alkali metal acid pyrophosphate; followed by (c) immersion in an aqueous solution of an alkaline earth metal halide alone or in combination with an alkali metal halide.

There is no pause between the three blanching steps, the good product being held in large wire baskets and dipped in one aqueous solution and then removed and dipped in the next solution.

The first blanch, i.e. blanch (a), is preferably carried out using an aqueous solution at a temperature of 155±35°F. and previously adjusted to a pH between 2.0 and 6.5 at 75°F to 80°F (about 25°C). The time of immersion of the food product in this first blanch may be from one to five minutes. A suitable concentration of citric acid or salt thereof is from 0.2 to 4% by weight, and similarly the concentration of ascorbic acid or salt thereof may be from 0.5 to 4% by weight. A mixture of citric acid and ascorbic acid may be used. The acid salts may be sodium or potassium salts and isomers of the acid or salt such as iso ascorbic acid may be used.

Alternatively, blanch (a) is carried out by using an aqueous solution containing sulphur dioxide, preferably 0.005 to .8% by weight, this sulphur dioxide being added to the aqueous solution in the form of a gas, an alkali metal metabisulphite or an alkali metal sulphite. Suitable such metabisulphites and sulphites are sodium metabisulphite, potassium metabisulphite, sodium sulphite and potassium sulphite. The tissue cells are believed to become associated with trace quantities of sulphur dioxide as a result of blanch (a), thus helping to control discolouration (browning) of the food during heat sterilization and storage.

In a particularly preferred embodiment of this invention, blanch (a) is effected with an aqueous solution containing from 0.2 to 4% by weight of citric acid, or salt thereof, in combination with from 0.005 to 0.8% by weight of sulphur dioxide either as such or in the form of an alkali metal sulphite or metabisulphite. We find that the combined use of citric acid and sodium metabisulphite is particularly useful.

In addition to controlling discolouration, blanch (a) also serves to expel intercellular gases in the food product and, when ascorbic acid is used, increases the vitamin C content of the resulting food product. The expelling of the inter-cellular gases at this stage prevents their subsequent accumulation in the food package.

Blanch (b) may also serve to introduce reducing saccharides into the food tissue to enhnace the flavour of the final product and to optimize non-enzymic browning when the product is subsequently fried.

Blanch (b) is preferably carried out by immersing the food product resulting from blanch (a) in an aqueous solution of an alkali metal acid pyrophosphate at a concentration of from 0.5 to 1.5% by weight and a reducing saccharide at a concentration of from 0.5 to 1.5% by weight at 160±20°F for from 15 to 60 seconds. The pyrophosphate serves to control greying (after-cook darkness) of the food tissue which is caused by the interaction of ferrous ions with ortho-diphenols present in the foods. Alkali metal pyrophosphates have been found to be effective anti-darkening agents which do not adversely alter the textural quality of the food tissue.

When necessary, for further flavour enhancement, non-reducing disaccharides may be incorporated in the aqueous solution of blanch (b). These disaccharides are used at a concentraion of from 2 to 25% by weight.

Preferred pyrophosphates used in blanch (b) or sodium acid pyrophosphate ($Na_2H_2P_2O_7$) and potassium acid pyrophosphate ($K_2H_2P_2O_7$). The preferred reducing saccharide is glucose.

After blanch (b), the food product is subjected to blanch (c), i.e. immersion in an aqueous solution of an alkaline earth metal halide, such as calcium chloride alone or in combination with an alkali metal halide, such as sodium chloride. The concentration of the alkaline earth metal halide should preferably be from 0.05 to 0.5% by weight, and that of the alkali metal halide up to 8% by weight. The time for immersion in the aqueous solution of blanch (c) is preferably from 15 to 60 seconds.

The solution used in blanch (c) may also contain an amylose-complexing agent, such as a fatty acid salt, a polyoxyethylene acid or monoglyceride and a surfactant such as polyoxyethylene sorbitan fatty acid ester. These agents aid in preventing the pieces of the food product from sticking together in the container.

Where required, the food product resulting from blanch (c) may be sprayed with a flavouring solution such as an onion oil solution, to give the product a particular flavour.

Blanch (c) serves to firm the food product texture by forming calcium pectate in the middle lamella between the cell walls, and it improves and enhances final product flavour through the introduction of a saline constituent.

This treatment process of the present invention is particularly suitable for use with white-fleshed vegetables, such as potatoes, cauliflower, onions, parsnips, apples and pears. The food product used in the treatment process may be whole, sliced, diced or any other convenient shape. The process is particularly suitable for use with potatoes,

especially french-fry potato strips. In this regard, it may be mentioned that results have shown that french-fry potato strips treated in accordance with the process of this invention vacuum packed in flexible containers, have, upon frying in oil, a better texture, colour and flavour than commercial frozen strips.

As mentioned above, the treatment process of this invention provides a raw fruit or vegetable product which, when processed in a flexible container, resists the effects of gassing and discolouration etc. which have caused problems in previously known attempts to process food products in flexible containers.

The subsequent sterilization of the treated food product is conveniently carried out by inserting the food product resulting from blanch (c) into a flexible, substantially impervious container, sealing the container under a partial vacuum, subjecting the sealed container to conditions of elevated temperature and pressure whereby the food product therein is sterilised, and finally cooling the sterilized product. The treated food product may be orientated in a particular manner or placed randomly in the container and the container is then thermally sealed. It is preferred to effect sterilization at a temperature between about 230° to 250°F. while subjecting the thermally sealed container to an external over-pressure exceeding the internal pressure of the flexible container by up to 15 p.s.i. gauge. In the sterilization process, the flexible containers are placed on perforated retort racks which ensure that the containers (positioned horizontally) remain separated, and permitting circulation of the steam heating medium. The over-pressure of up to 15 p.s.i. gauge is required until the product has cooled sufficiently to prevent bursting of the containers by internal water vapour pressure. It is preferred to use compressed, hot air to bring about this over-pressure.

The material used for the flexible containers should be impervious to bacteria and micro-organisms, and should be heat-stable and non-toxic. Suitable such materials are polymers and laminates based on polymers and aluminum foil, such as, nylon/polyethylene, nylon/aluminum foil/polyethylene, polyester/polyolefin, nylon/polyolefin, polyester/aluminum foil/polyolefin and nylon/aluminum foil/polyolefin. MYLAR (trade mark) is a suitable polyester material. The container made of these materials may be notched to facilitate ease of opening.

In a preferred embodiment, after the treated food product has been introduced into the container, but before the container has been thermally sealed, a partial vacuum of 10±8 inches of Hg is drawn. Under such a partial vacuum, the pieces of food product show a minimal tendency to stick or adhere together so that they subsequently pour freely from the container for final heating and serving. In this regard, in a further preferred embodiment, prior to applying the partial vacuum a gas consisting of 0 to 15% oxygen and 85 to 100% nitrogen may be introduced into the container to promote the development of natural product flavours and prevent the development of off-flavours.

The final step in the overall treatment and sterilization process is the sterilization of the treated food product in the partially evacuated, sealed flexible container. As mentioned above, this sterilization is preferably carried out at 230-250°F. The time for this heating varies depending upon the size of the packed container, for example, a 1 lb. pack may require heating for around 50 minutes at 250°F, whereas a 5 lb. pack will required heating for around 95 minutes at this temperature in order to effect proper sterilization. The purposes of the sterilization is to inactivate aerobic, anaerobic and putrefactive organisms which might be introduced into the food product or the flexible container during the preparation and handling processes. It should be noted that it is not the intent of the sterilization step to cook the product in a conventional sense, though in the process of achieving internal container sterilization, the food product is cooked to a certain extent so that, in general, when it is subsequently removed from the container it only requires a short period of heating before it can be served.

Preservation of the food product after the sterilization step, and non-refrigerated shelf stability, are assured by the absence of micro-organisms in the container, and hence no internal micro-biological growth, and by the protective barrier to oxygen and water vapour provided by the container material. The shelf-stable feature of the sterilized food product in the flexible containers at room temperature is advantageous from the standpoint of ease of handling, transportation, and storage.

The process of this invention is illustrated in detail by the following non-limiting examples. The proportions and percentages used herein are by weight unless otherwise specified.

Example 1

Potato french-fry slices are immersed in an aqueous solution of 0.15% sodium metabisulfite and 2% citric acid adjusted to pH 5.8 at 25°C with sodium hydroxide solution. The slices are held in this solution at 190°F for 1 minute. Next, the potatoes are immersed in an aqueous solution consisting of 1% dextrose and 1% sodium acid pyrophosphate at 180°F for 20 seconds. Finally the potatoes are immersed in an aqueous

solution containing 0.2% calcium chloride and 6% sodium chloride at 180°F for 30 seconds.

The potatoes are placed in mylar/aluminum foil/polyolefin laminated pouches (about one pound per pouch), flushed with nitrogen for about 1 minute and sealed after the pressure in the pouches is adjusted to 17 in of Hg gauge. The pouches are retorted at 250°F for 45 minutes.

The subsequently fried product had a golden brown surface crust, a firm texture, a desirable potato flavour and a white interior.

Example 2

Cauliflower florets (about 1 to 2 inches in diameter) are immersed in an aqueous solution (about pH 2.3) of 0.15% sodium metabisulfite and 2% citric acid at 190°F for 1 minute. The cauliflower pieces are next immersed in 1% sodium acid pyrophosphate aqueous solution at 180°F for 20 seconds. Finally the cauliflower pieces are immersed in an aqueous solution of 4% sodium chloride and 0.6% calcium chloride at 180°F for 30 seconds.

The cauliflower pieces are placed immediately in MYLAR/aluminium foil/polyolefin laminated pouches (about one pound per pouch), flushed with nitrogen for about 1 minute and sealed after the pressure in the pouches is adjusted to about 17 inches of Hg gauge. The pouches are retorted at 250°F for 25 minutes.

The final product with a pH of about 5.0, has a pleasant cooked cauliflower odour and flavour, white surface and interior and fairly firm texture. The heated product could be served with or without a sauce.

Example 3

Newtown apple slices (1/4 to 1/2 inches in diameter) are immersed in an aqueous solution (about pH 2.3) of 0.15% sodium metabisulfite and 2% citric acid at 190°F for 1 minute. The apple slices are next immersed in an aqueous solution of 1% sodium acid pyrophosphate and 5% sucrose at 180°F for 20 seconds. Finally the slices are immersed in an aqueous solution of 0.2% calcium chloride at 180%F for 30 seconds.

The slices are placed immediately in MYLAR/aluminum foil/polyolefin laminated pouches (about one-half pound per pouch), flushed with nitrogen for about 1 minute and sealed after the pressure in the pouches is adjusted to about 17 inches of Hg gauge. The pouches are retorted at 250°F for 10 minutes.

The final product, with a pH of 3.1, has a pleasant baked apple flavour, slightly tart taste, creamy colour and firm texture.

WHAT WE CLAIM IS:—

1. A process for treating a raw food product, which comprises: (a) immersing the food product in an aqueous solution of citric acid, ascorbic acid, a salt or citric or ascorbic acid, sulphur dioxide added to the solution in free form, as an alkali metal sulphite or as an alkali metal metabisulphite, or a mixture of two or more of said compounds; followed by (b) immersion in an aqueous solution of an alkali metal acid pyrophosphate; followed by (c) immersion in an aqueous solution of an alkaline earth metal halide alone or in combination with an alkali metal halide.

2. A process as claimed in Claim 1 wherein the solution of step (a) comprises 0.2 to 4% by weight of citric acid, or salt thereof and/or 0.5 to 4% by weight of ascorbic acid or salt thereof.

3. A process as claimed in Claim 1 or Claim 2 wherein the solution of step (a) comprises 0.005 to 0.8% by weight of sulphur dioxide.

4. A process as claimed in any of the preceding claims wherein the immersion of product in the solution of step (a) is for 1 to 5 minutes at a temperature of 155±35°F the solution having a pH of 2.0 to 6.5 measured at 75° to 80°F.

5. A process as claimed in any of the preceding claims wherein the solution of step (b) comprises up to 1.5% by weight of a reducing saccharide.

6. A process as claimed in any of the preceding Claims wherein the solution of step (b) compirses 0.5 to 1.5% by weight of alkali metal pyrophosphate.

7. A process as claimed in any of the preceding claims wherein the immersion of product in the solution of step (b) is for 15 to 60 seconds at a temperature of 160±20°F.

8. A process as claimed in any of the preceding claims wherein the solution of step (c) comprises 0.05 to 0.5% by weight of alkaline earth metal halide and up to 8% by weight of alkali metal halide.

9. A process as claimed in any of the preceding Claims wherein the immersion of product in the solution of step (c) is for 15 to 60 seconds.

10. A process as claimed in any of the preceding Claims which incorporates the additional steps of inserting the food product resulting from step (c) into a flexible, substantially impervious container, sealing the container under a partial vacuum, subjecting the sealed container to conditions of elevated temperature and pressure whereby the food product therein is sterilized, and finally cooling the sterilized product.

11. A process as claimed in Claim 10 wherein the food product is sterilized by subjecting the sealed container to a temperature between 230 and 250°F.

12. A process as claimed in Claim 10 or Claim 11 wherein the sealed container is subjected to an external pressure exceeding

the internal pressure of the container by up to 15 p.s.i. gauge.

13. A process as claimed in any of Claims 10 to 12 wherein the container is sealed under a partial vacuum of 10 ± 8 inches of Hg gauge.

14. A process as claimed in any of Claims 10 to 13 wherein, prior to applying the partial vacuum a gas consisting of up to 15% oxygen and 85 to 100% nitrogen is introduced into the container.

15. A process as claimed in any of Claims 10 to 14 wherein the container is made of nylon/polyethylene, nylon/aluminium foil/ polyethylene, polyester/polyolefin, nylon/ polyolefin, polyester/aluminium foil/ polyolefin or nylon/aluminium foil/polyolefin.

16. A process as claimed in any of the preceding Claims wherein a solution of ascorbic acid is used in step (a).

17. A process as claimed in any of Claims 1 to 15 wherein a solution of citric acid is used in step (a).

18. A process as claimed in any of the preceding Claims wherein the alkali metal acid pyrophosphate of step (b) is sodium acid pyrophosphate or potassium acid pyrophosphate.

19. A process as claimed in any of Claims 5 to 18 wherein the reducing saccharide of step (b) is glucose.

20. A process as claimed in any of the preceding Claims wherein the solution of step (b) also contains from 2 to 25% by weight of a non-reducing disaccharide.

21. A process as claimed in any of the preceding Claims wherein the alkaline earth metal halide of step (c) is calcium chloride.

22. A process as claimed in any of the preceding Claims, wherein the alkali metal halide of step (c) is sodium chloride.

23. A process as claimed in any of Claims 3 to 15 or 18 to 22, wherein the solution of step (a) contains in combination (i) 0.005 to 0.8% by weight of sulphur dioxide, and (ii) either from 0.2 to 4.0% by weight of citric acid or a salt thereof, or from 0.5 to 4.0% by weight of ascorbic acid or a salt thereof.

24. A process as claimed in any of the preceding claims wherein the sulphur dioxide is added to the solution in the form of a sodium metabisulphite, potassium metabisulphite, sodium sulphite or potassium sulphite.

25. A process as claimed in any of the preceding Claims wherein the aqueous solution of step (c) also contains an amylose-complexing agent and a surfactant.

26. A process as claimed in Claim 25, wherein the amylose-complexing agent is a fatty acid salt, a polyoxyethylene acid, or a monoglyceride and the surfactant is a polyoxyethylene sorbitan fatty acid ester.

27. A process as claimed in any of Claims 10 to 26 wherein the food product resulting from step (c) is first sprayed with a flavouring solution before insertion into the flexible, substantially impervious container.

28. A process as claimed in any of the preceding Claims wherein the raw food product is a raw vegetable or fruit product.

29. A process as claimed in Claim 28 wherein the product is potato, cauliflower, onion, parsnip, apple or pear.

30. A process as claimed in any of the preceding Claims wherein the product is whole, sliced or diced potato.

31. A food package comprising a stabilized food product prepared by the process of any of the preceding claims sealed under partial vacuum in a flexible impervious container wherein at least traces of a gas mixture of up to 15% by weight oxygen and from 85 to 100% by weight nitrogen are also sealed within the container.

32. A food package as claimed in Claim 31 wherein tissue cells of the food product are associated with trace quantities of sulphur dioxide.

33. A food package as claimed in Claim 31 or Claim 32 wherein the food product contains an alkali metalacidpyrophosphate.

34. A food package as claimed in any of Claims 31 to 33 wherein the food product contains a saccharide.

35. A food package as claimed in any of Claims 31 to 34 wherein the food product contains an amylose-complexing agent and a surfactant.

36. A food package as claimed in any of Claims 31 to 35 wherein calcium pectate is formed in the middle lamellae between the cell walls of the food product.

37. A process for treating a raw food product substantially described herein with reference to the Examples.

38. A food product treated by the process described herein with reference to the Examples.

39. A food package substantially as described herein with reference to the Examples.

KILBURN & STRODE,
Chartered Patent Agents,
Agents for the Applicants.

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